IATROGENIC EFFECTS OF REMOVABLE ORTHODONTIC APPLIANCES

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Undesirable effects that occur during orthodontic treatment can be attributed to a lack of understanding of physics involved and individual variations in biologic response. A proper insight into the biomechanical principles underlying orthodontic appliance therapy is indispensable for executing efficient orthodontic treatment. While designing, one of the aspects that is frequently neglected is the direction of force applied (vector) on the teeth by active components. Knowledge of vectors would help a dentist decide the placement of active components and thereby foresee the results obtainable. Through these case reports it is emphasized that every step of removable appliance therapy should be carefully monitored by an experienced clinician himself and if iatrogenics arise, then its recognition and rectification is mandatory

INTRODUCTION

It is aptly put forth "To err is human". Removable appliances are orthodontic and/or orthopaedic devices that can be inserted and removed from the oral cavity by the patient. A survey of the literature shows that removable appliances are being used to a greater extent than the fixed appliances mainly because of socio-economic reasons1. Regardless of this fact, most dental practitioners pay very little attention while designing removable appliances. The primary reason for this can be attributed to the prevalence of a notion amongst them that the use of removable appliances is technically less demanding when compared to fixed appliances. As a result, quite a few appliances constructed, though displaying beautiful workmanship, are rendered useless function wise and further may be iatrogenic. Therefore, it must be emphasized that every step of removable appliance therapy should be carefully monitored by the dentist himself.

As early as first century A.D., Celsus reported that erupting malpositioned teeth could be directed into their proper place by application of finger pressure. "Der Schiefstandder Zahne" published in 1836, by F.CH Kneisel, paved the way and opened new horizons for the widespread use of removable appliances in Orthodontia. The removable appliances were historically used mainly in Europe. The competition between removable and fixed appliances has reigned up to recent years, mainly due to habit rather than based on scientific knowledge. When the European and American schools became scientifically closer, the situation modified towards an integration of these devices in daily clinical practice.

First removable plate designed by Sir. John Tomes in 1845 was made of metal and equipped with elastic springs. "Kingsley", one of the pioneers of modern Functional jaw orthopaedics, introduced the concept of "jumping the bite" (for functional mandibular retrusion), with the aid of bite plate incorporating an anterior inclined plane. Modern split expansion plate was first designed by Coffin. The first retention plate was designed by Hawley[2].

The choice of removable appliance depends upon many factors such as the direction, distance and the number of teeth to be moved. Further it also depends upon patient compliance and the general therapeutic program.

According to glossary of Dentofacial terms, compiled by American Association of Orthodontists in 2006, 'Iatrogenic' means 'an unfavourable response induced by a therapeutic effort'. Failure to observe fundamental principles of removable appliance design, activation and management can lead to iatrogenic effects in removable appliance therapy. The

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objective of this article is to highlight the iatrogenic effects of improper /inadvertent management of removable appliances which were elicited as undesirable movement of a single or a group of teeth. Case reports of outdoor patients who were followed-up by BDS students and interns in our under-graduate clinics are presented.

CASE REPORTS

I. Canine Intrusion

The patient reported to Department of Orthodontics with the chief complaint of spacing between upper front teeth. Upon subsequent visits it was observed that iatrogenicity was caused as the result of incorrect inciso-gingival position of labial bow during fabrication i.e., left side of the labial arch is embracing the tip of upper left cuspid leading to intrusion & localised periodontal breakdown (Fig 1).

II. Canine intrusion & Axiversion bilaterally

The point contact between the mesial leg of the canine loop and the canine is below the area of greatest convexity, thus accentuating the intrusion bilaterally (Fig 2 & 3). Such iatrogenics precludes the potential for cuspid protected occlusion.

III. Lateral incisor Intrusion & Axiversion

Failure to maintain the correct inciso-gingival position of the labial bow in relation to lateral incisor & further its over activation has led to intrusion of lateral incisor (Fig 4). Rectification of the iatrogenicity after adjusting the position of labial bow in relation to lateral incisor is depicted in Fig 5.

IV. Canine extrusion

Patient reported with chief complaint of crowded anterior teeth (Fig 6 Class II Div 2). Treatment was initiated with sectional anterior expansion appliance with anterior bite plate[3]. Photograph (Fig 7) taken during course of treatment depicts considerable bite opening and correction of axial inclination of upper central incisors. However, an undesirable effect was elicited i.e. canine extrusion as a consequence of labial bow over activation.

A Semi-fixed appliance was used in conjunction with light elastics in "V" configuration (cradle form). Fig. 8 shows resolution of the iatrogenicity.

V. Incisor extrusion

The case shows continued labial bow activation despite consolidation of upper anterior spaces and further, failure to trim the palatal acrylic (Fig 11). Fig 12 shows two most common errors in trimming palatal acrylic from the path of an advancing tooth. Side 1 depicts over-trimming while side 2 shows under-trimming.

DISCUSSION

The common meaning of iatrogenics suggests that this refers to something "induced unintentionally by the treatment." In this broad context, iatrogenics might involve some problems caused to the patient. This is recognized in the orthodontic publications mainly in terms of failures in patient compliance that results in poor treatment, no improvement, or damage. The examples here are numerous: lapses in oral hygiene, attention to appointment schedules, communication, and caring for and wearing various devices all of which can make the achievement of optimal correction difficult if not impossible. So can the maintenance of deleterious habits.

Also within the broad context of iatrogenics it is important to recognize that occasionally there are materia technia problems. Not all commercial products have been safe and effective. Early extraoral appliances had no safety protection[4,5]. Nickel in stainless steel can cause allergies to some. The disastrous effects of teflon-coated proplast joint implants used in temporomandibular joint surgery are an example in a related specialty.

In a stricter sense, the derivation of the word iatrogenics suggests a more pointed concern in that the unpredictable treatment effect comes "from the doctor." In terms of failures by the practitioner, examples are extensive and may involve both commission and omission that may occur before, during, and after treatment. For example, complicating psychological, medical, and dental conditions can go unno-

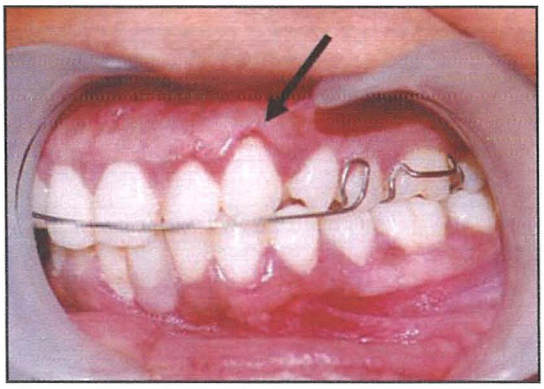


Fig 1 - Lateral view of the patient showing localized periodontal breakdown.

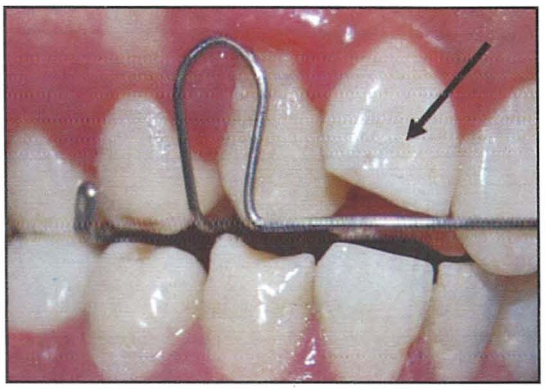
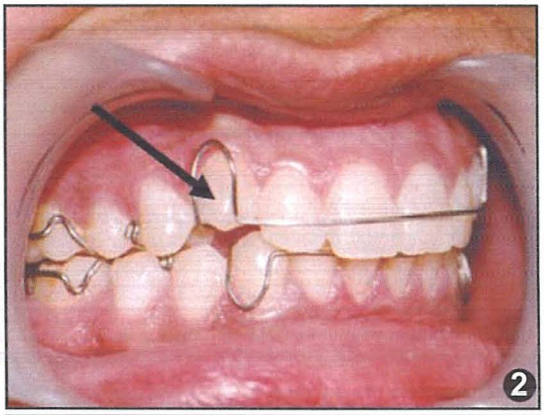


Fig 4 - Right lateral view shows overactivation leading to axiversion and intrusion of lateral incisor.



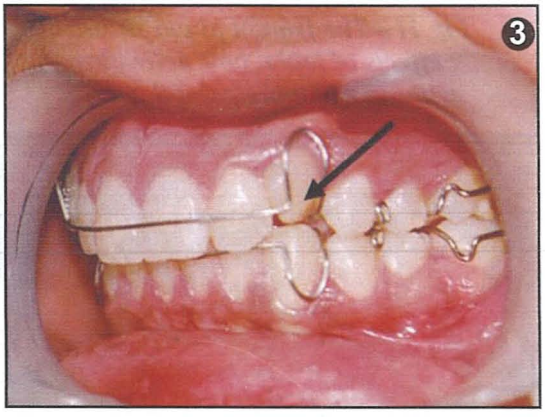


Fig 2 & 3 - photograph shows bilateral canine intrusion and axiversion.

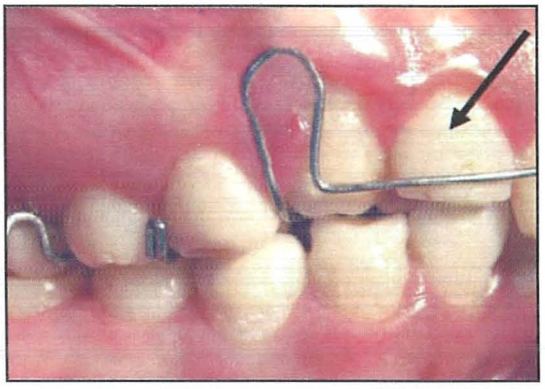


Fig 5 - Right lateral view shows rectification of the iatrogenicity.



Fig 6 - Pretreatment photograph shows crowding of upper anterior teeth. (Class II Div 2)

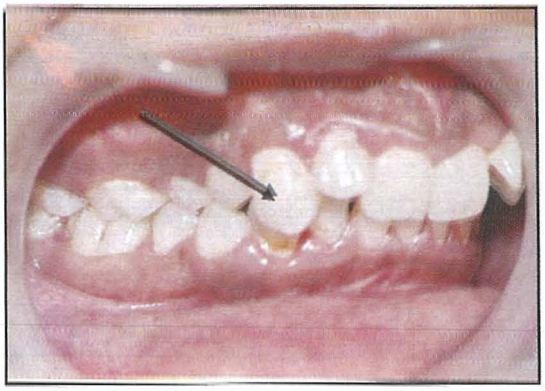


Fig 7 - Stage photograph shows bite opening, improvement of central incisors inclination but extrusion of canine.

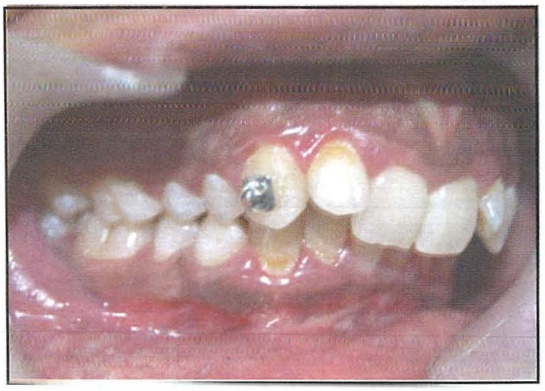
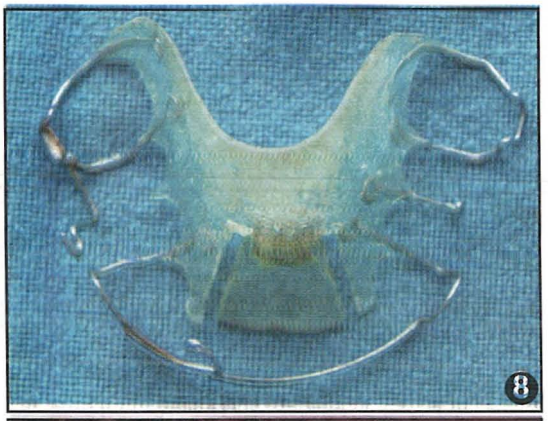


Fig 10 - Shows reduction of iatrogenicity.



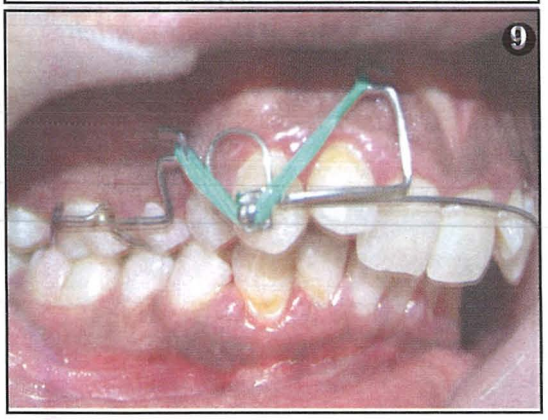


Fig 8 & 9 - Semi fixed apliance use with light elastics in "V" configuration used to intrude the canine.

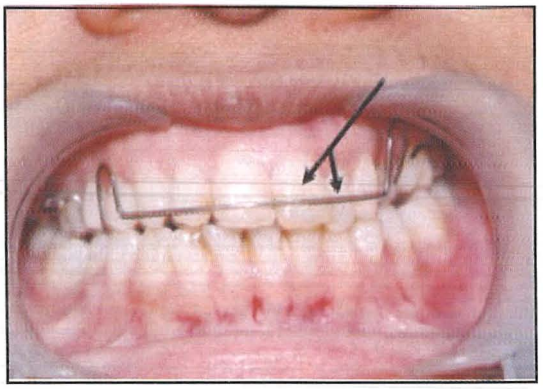


Fig 11 - The frontal photo shows ill effects of labial bow activation without trimming palatal acrylic.

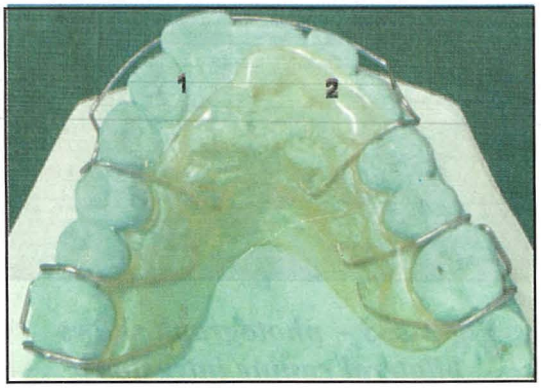


Fig 12 - Two most common errors in trimming palatal acrylic. Side 1 depicts over-trimming while side 2 shows under-trimming.

ticed. The practitioner might not recognize that a malocclusion exists or its extent and might fail to estimate the difficulty of the required treatment or diagnose the case incorrectly. Other difficulties might result from a failure to consult with appropriate generalists and specialists in dentistry or other healthcare providers; failure to refer appropriately; adoption of an incorrect or dangerous treatment strategy; failure to execute treatment properly; failure to perform treatment at the proper time (i.e., during a "window of opportunity"); failure to appropriately alter treatment as necessary; failure to resolve the malocclusion (i.e., finish the treatment); failure to provide follow-up care; and failure to properly manage and communicate with the patient.

All such shortcomings could materially and significantly impact the attainment, quality, and maintenance of the correction. If the practitioner does not execute treatment properly, poor facial, gingival, and dental aesthetics might result; the correction of the malocclusion and stability of the obtained result might be compromised or lacking; treatment time might be extended, and damage to the teeth, pulp, supporting tissues, and facial structures, and the patient's general health might be produced. Ethical and legal considerations also seem to focus on this aspect of iatrogenics6.

While designing, one of the aspects that is frequently neglected is the direction of force applied (vector) on the teeth by active components. Knowledge of vectors would help a dentist decide the placement of active components and thereby foresee the results obtainable. Failure to observe fundamental principles of removable appliance design, activation and management can lead to iatrogenic effects in removable appliance therapy.

Finally, a special iatrogenic classification seems in order because certain undesirable and unpredictable occurrences can happen seemingly without attributable cause or pattern on the part of the patient7, manufacturers, or doctor. Such are probably related to the state of our knowledge in that true disagreement exists as to the cause or agent of the untoward event. The topics of relapse, root resorption, loss of alveolar crest8, some forms of periodontal damage, unfavorable growth, and temporomandibular joint disorders best appear in this category for the time being. Iatrogenicity can arise at two levels:

a) Extrinsic: At the operator level

1. Diagnosis and treatment planning:
   - Incorrect choice of treatment mechanics
   - Incorrect choice of extractions
   - Poor anchorage control
2. Appliance design and activation:
   - Poor fit of appliance - Poorly fitted wire elements can interfere with tooth eruption
   - Retentive components ineffective-This will allow displacement of appliance with a reduction in efficiency of the spring and will be uncomfortable for the patient
   - Incorrect positioning of active wire elements e.g. Improper incisо-gingival placement of labial bow
   - Base plate trimmed incorrectly –Failure to clear acrylic/bunched soft tissue from the path of the advancing tooth can hinder tooth movements
   - Trauma-Incorrectly placed or adjusted springs or labial wire can cause trauma, which in turn will discourage appliance wear
   - Inadequate instructions given to the patient regarding appliance wear and maintenance

b) Intrinsic: At the patient level. This constitutes a very miniscule part of iatrogenics. It mainly include compliance factors.

- Irregular attendance at appointments
- Irregular appliance wear and maintenance leading to an appropriate appliance becoming iatrogenic

SUMMARY

Many of the undesirable effects that occur during orthodontic treatment can be attributed to a lack

of understanding of physics involved and individual variations in biologic response. The delayed reaction inherent in removable mechanics makes the whole affair a long drawn out process and is conducive to the production of inadequate results. Empericism in orthodontic appliance design must give way to a new discipline of orderly appliance development using concepts from the physical and biologic sciences. Understanding and a proper insight into the biomechanical principles underlying orthodontic appliance therapy is indispensable for executing efficient orthodontic treatment.

Thus there are many ways in which the patient might be harmed iatrogenically. While there is a natural aversion to admitting mistakes and difficulty9, beyond mere curiosity, it seems important to consider the circumstances where orthodontic treatment does not proceed as planned or hoped, where difficulties are encountered and unfavourable outcomes are produced10 that might affect the patient, practitioner, profession, specialty and, perhaps, society at large. In this sense, the study of treatment difficulties provides an opportunity to gain perspective and work toward improvement in the quality of care afforded patients. Failures are sobering reminders of the imperfections of our knowledge and what advancement is still needed.

Damage is the handmaiden especially with beginners, unless proper training and experience are the basis for rendering of quality orthodontic services. If iatrogenics arise, then its recognition and rectification is mandatory for orthodontics to reach greater heights in both theory and practice.

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